KING FAHD UNIVERSITY OF PETROLEUM & MINERALS

ELECTRICAL ENGINEERING DEPARTMENT

FIRST SEMESTER 2012-2013 (S121)

Course Title:	**Electronics II**
Course Number:	**EE 303**

Exam Type:	**Exam II**
Date:	**Wednesday November 28, 2012**
Time:	**6:00PM-7:30PM**

Student Name: ______________________________

Student ID: ______________________________

Section # ______________________________

GRADING		
Question 1	**10**	
Question 2	**15**	
Question 3	**15**	
Question 4	**20**	
Total:	**60**	

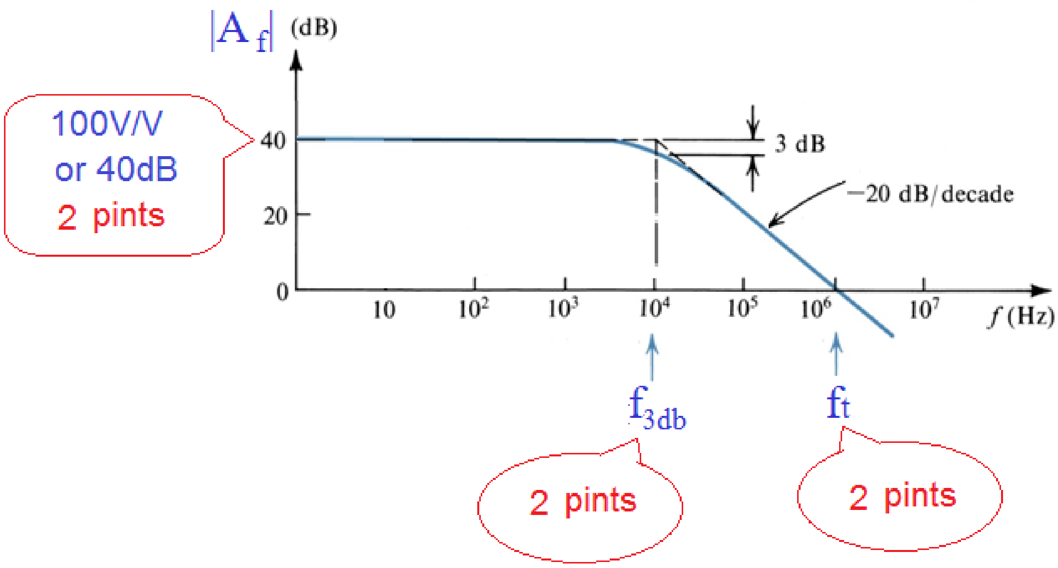
Show all your work and results. Do not give more than one answer otherwise the wrong one will be considered.

Question No.1: (10 points)

It is required to design a non-inverting amplifier with a closed loop gain of 100 V/V, given that the op-amp used has a dc gain of 10^5 V/V and a unity-gain frequency of 10^6 Hz, draw the closed-loop gain frequency response.

Label all the critical points on x and y axis

BW_{CLG}= f_t/CLG = 10^4 Hz → (4 Points)

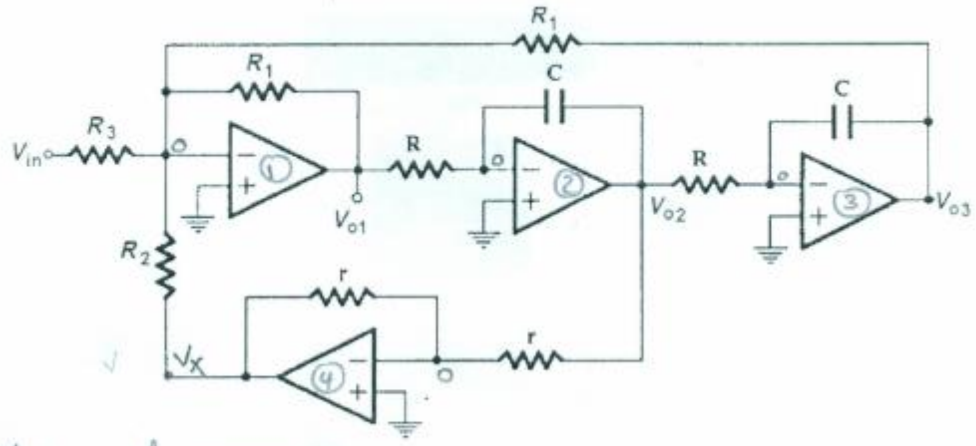


Question No.2: (15 points)

For the active filter circuit shown below:

a) Derive the transfer function for output (**V_{o1}/V_{in}**).

b) Identify the order and the type of the filter.



a) KCL at (-) of opamp1

$$\frac{V_{in}}{R_3} + \frac{V_{o3}}{R_1} + \frac{V_x}{R_2} + \frac{V_{o1}}{R_1} = 0 \quad ①$$

3 Points

$$V_x = -\frac{r}{r} V_{o2} = -V_{o2} \quad \& \quad V_{o2} = -\frac{1}{SCR} V_{o1}$$

$$② \quad V_x = \frac{1}{SCR} V_{o1}$$ 3points ; $$V_{o3} = -\frac{1}{SCR} V_{o2} = \frac{1}{S^2C^2R^2} V_{o1} \quad ③$$ 3points

From ①, ②, ③ $\Longrightarrow$ $$\frac{V_{in}}{R_3} + \frac{1}{s^2c^2R^2}\frac{V_{o1}}{R_1} + \frac{V_{o1}}{R_2}\frac{1}{SCR} + \frac{V_{o1}}{R_1} = 0$$

$$V_{o1}\left[\frac{1}{R_1 s^2c^2R^2} + \frac{1}{R_2 SCR} + \frac{1}{R_1}\right] = \frac{V_{in}}{R_3}$$

$$V_{o1}\left[\frac{1}{c^2R^2} + \frac{R_1}{R_2 CR} S + S^2\right] = \frac{S^2 R_1}{R_3} V_{in}$$

$$\frac{V_{o1}}{V_{in}} = \frac{\frac{R_1}{R_3} S^2}{S^2 + \frac{R_1}{CR_2R} S + \frac{1}{C^2R^2}} \quad ⊛ ⊛$$

3 Points

b) 2nd order high pass filter 3points

Question No.3: (15 points)

Consider the following filter transfer function:

$$T(s) = \frac{(\frac{1}{C_2 R_2})s}{s^2 + (\frac{1}{C_1 R_2})s + \frac{1}{C_1 C_2 R_1 R_2}}$$

Design the filter such that it has a center frequency of 1 krad/s, a bandwidth of 200 rad/s, and a center-frequency gain of 2 V/V. Assume $C_1 = 0.5$ μF.

Center freq. $= \omega_o = \frac{1}{\sqrt{C_1 C_2 R_1 R_2}} = 1K$ rad/s 3 Points

$BW = \frac{1}{C_1 R_2} = 200$ rad/s (2) 3 Points

Center freq. gain $= \frac{C_1}{C_2} = 2$ V/V (3) 3 Points

C_1 is given $0.5\mu F$ $\xRightarrow{\text{from (3)}}$ $C_2 = 0.25\mu F$ 2 Points

From (2) $\frac{1}{0.5\mu \times R_2} = 200 \Rightarrow R_2 = 10K\Omega$ 2 points

From (1) $\omega_o^2 = \frac{1}{0.5\mu \times 0.25\mu \times R_1 \times 10K}$ 2 Points

$R_1 = 800\Omega$

Question No. 4: (20 points)

A series-shunt feedback amplifier employ a basic amplifier with input and output resistance each of 1kΩ and gain A = 2000 V/V. The feedback factor β = 0.1 V/V. Find:

a) the closed loop gain (A_f).
b) the input resistance for the closed loop amplifier.
c) the output resistance for the closed loop amplifier.
d) If a manufacturing error results in a reduction of A to 1800V/V, What is the new value for the closed loop gain (A_f)? Comment on your result.

a) $A_f = \frac{A}{1+\beta A}$

$A_f = \frac{2000}{1+(0.1)(2000)} = 9.950\ \frac{V}{V}$ → (4 Points)

b) $R_{if} = R_i(1+\beta A)$

$R_{if} = (1)(201) = 201k\Omega$ → (4 Points)

c) $R_{of} = \frac{R_O}{1+\beta A}$

$R_{of} = \frac{1}{1+200} = 5\Omega$ → (4 Points)

d) $A_{f\ (new)} = \frac{A_{new}}{1+\beta A_{new}} = \frac{1800}{1+(0.1)(1800)} = 9.945\frac{V}{V}$ → (4 Points)

The % change in A_f is less than the % change in A by the amount of the feedback.

→ (4 Points)